PART I: OVERVIEW AND PROCESS DESCRIPTION

PURPOSE

Ecological work plans must identify the procedures to be used for an ecological assessment at a particular site and describe the rationale and objectives for ecological data acquisition at the site. Details for collection, analysis, and quality assurance of ecological data are to be described in a ***sampling and analysis plan***. Guidance on developing these plans is presented in Part II of the document.

This guidance document (1) provides instructions on preparing the components of an ecological work plan to complement the overall site remedial investigation/feasibility study (RI/FS) work plan and (2) directs the user on how to implement ecological tasks identified in the plan. Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), an RI/FS work plan will have to be developed as part of the site-remediation scoping process. Specific guidance on the RI/FS process and the preparation of work plans has been developed by the U.S. Environmental Protection Agency (EPA 1988a). ***This document provides guidance to U.S. Department of Energy (DOE) staff and contractor personnel for incorporation of ecological information into environmental remediation planning and decision making at CERCLA sites.*** An overview analysis of early ecological risk assessment methods (i.e., in the 1980s) at Superfund sites was conducted by the EPA (1989a). That review provided a perspective of attention given to ecological issues in some of the first RI/FS studies. By itself, that reference is of somewhat limited value; it does, however, establish a basis for comparison of past practices in ecological risk with current, more refined methods.

Because many DOE field office staff are involved in decisions that require ecological information, it is important that the applicability of basic ecological concepts and ecological impact assessment methodologies to contaminated waste site remediation be clearly understood. The user of this guidance document will find references to ecological information and evaluations that may be required at various stages of the RI/FS process. Guidance is provided in the form of discrete modules that contain step-by-step procedures for specific tasks. The guidance provided herein is also applicable, in part, to the needs of DOE line managers charged with the responsibility for conducting natural resource damage assessments (NRDAs), although NRDAs are not the subject of this document.

This guidance document also provides an overview of the RI/FS process. Each element of the process is addressed relative to ecological assessment planning, evaluation, and risk determination. Detailed descriptions of specific field and laboratory ecological or toxicity testing methods are not included in this document. Where possible, guidance is included for determining the adequacy of methods needed to conduct an ecological assessment (e.g., quantitative versus qualitative methods, laboratory versus field analyses, or situations requiring both field sampling and laboratory testing).

DESCRIPTION OF THE ECOLOGICAL RISK ASSESSMENT PROCESS

The distinction between an *ecological assessment* and an *ecological risk assessment* should be considered before the guidance set forth in this document is used. These terms are often used interchangeably among ecologists and in the scientific and regulatory literature, but in terms of the CERCLA process, there are differences between their meanings. Ecological assessments have evolved through time with passage of the National Environmental Policy Act (NEPA) in 1969. Historically, ecological assessments have been used to determine the impacts to ecological systems resulting from proposed human activities and have included predictions of impact, risk, and damage to these systems. Ecological assessments also have been used to support development of environmental standards based on laboratory and field measures of toxicological effects of pollutants. An ecological risk does not occur unless a stressor (1) has an inherent ability to cause one or more adverse effects and (2) co-occurs with or contacts an ecological component (i.e., organism, population, community, or ecosystem) long enough and at a sufficient intensity to elicit the identified adverse effect. A stressor, for purposes of this guidance document, is a radiological, chemical, or physical entity that can induce an adverse effect to individual organisms or populations or can cause loss of an ecosystem function. Ecological risk assessments at the CERCLA site will often involve more than one stressor and ecological component. This definition of ecological risk assessment will be implied throughout the guidance document.

The EPA (1992a) defines *ecological risk assessment* as the process of evaluating the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.

An ecological risk assessment may be warranted at several stages in the RI/FS process. In an emergency situation, an assessment may be required in a relatively short time when removal actions must be performed quickly. In certain situations, ecological data should be collected during all stages of the remediation process. These data may support an ecological risk assessment to determine the baseline of potential and actual effects on biota and habitats in the absence of remedial action or to ensure an environmental standard is

***Preparation of an RI/FS Work Plan* will require that ecologists become familiar with information on (1) the hazardous substances being evaluated, (2) the scoping process, (3) baseline risk assessment procedures, and (4) details of site ecosystem dynamics. The modules used in this guidance establish a logical sequence of stages in the RI/FS process and emphasize the need to consider ecological information at each stage.**

being met during remediation. Data collected before and during remediation will be useful in designing programs to monitor long-term effectiveness in cases where the technology used for the remedial action is relatively new.

Considerable attention has been given recently to conducting ecological risk assessments. Suter (1993) provides information on assessment and measurement endpoints, toxicity assessments, and the importance of models in ecological risk assessment. Maughan (1993) evaluates issues related to ecological risk from a regulatory perspective and includes case studies of two Superfund sites in the northeastern United States. Bartell et al. (1992) present a risk prediction methodology for measuring toxic chemical effects on natural aquatic ecosystems.

The major emphasis of this document is on ecological issues pertinent to developing an ecological work plan as a component of the overall RI/FS work plan. However, guidance is also presented on how to determine when an ecological risk assessment is needed and what ecological input is needed to implement commitments made in the record of decision documenting the selected remedial action. The latter may require ecological monitoring to document remedial action effectiveness.

Information obtained in examining the four information categories should be summarized and presented in background sections of the ***ecological work plan.*** These sections will support the rationale described in descriptive sections of the work plan for laboratory testing and field sampling/measurements. ***Unless detailed planning is carried out to identify:*** (1) appropriate species to be sampled, (2) measurement and assessment endpoints, and (3) hazardous substance characteristics, ***the work plan may describe laboratory and field sampling activities that are inappropriate for providing data needed by analysts conducting the baseline risk assessment.*** This point cannot be overemphasized. Also, the establishment of Biological Technical Assessment Groups by the EPA to provide technical assistance in the RI/FS process can serve to focus the ecological data collection needs before and during preparation of the work plan.

The most important categories of information to be considered by ecologists in preparing the ecological work plan are:

- Applicable statutes and regulations governing natural resources,
- Knowledge of the hazardous substances' radiological/chemical characteristics and distributions,
- Ecological resources that are or may be receptors and associated measurement and assessment endpoints, and
- Extent of contamination of both on-site and off-site ecosystems from site exposure.

DOCUMENT FORMAT

An overview of the RI/FS process is shown in Figure 1.1. The outline of this document follows this overview figure, showing the various stages where ecological input is needed for the decision maker. Specific stages in the RI/FS planning, scoping, and work plan development and implementation processes requiring ecological input and technical decisions are depicted in Figures 1.2 and 1.3.

Part I of this document provides an overview and description of ecological aspects necessary for proper planning and scoping of the RI/FS. Part II presents diagrams and associated text detailing modules related to the ecological work plan development and implementation. Each module contains graphics to orient the user to the current location in the overall guidance document and to guide the user to subsequent document sections. The modules are designed to guide the user on "what to do" and "when to do it" in ecological planning and decision making for the RI/FS process. The modules present guidance information in a concise manner, generally in step-wise fashion. However, activities depicted in some modules may be taking place within the same general time period. For example, initial preparation of a work plan approach could occur during project scoping (Module 5), concurrent with developing a site ecological conceptual model (Module 6) and conducting detailed characterization of site physical features (Module 7).

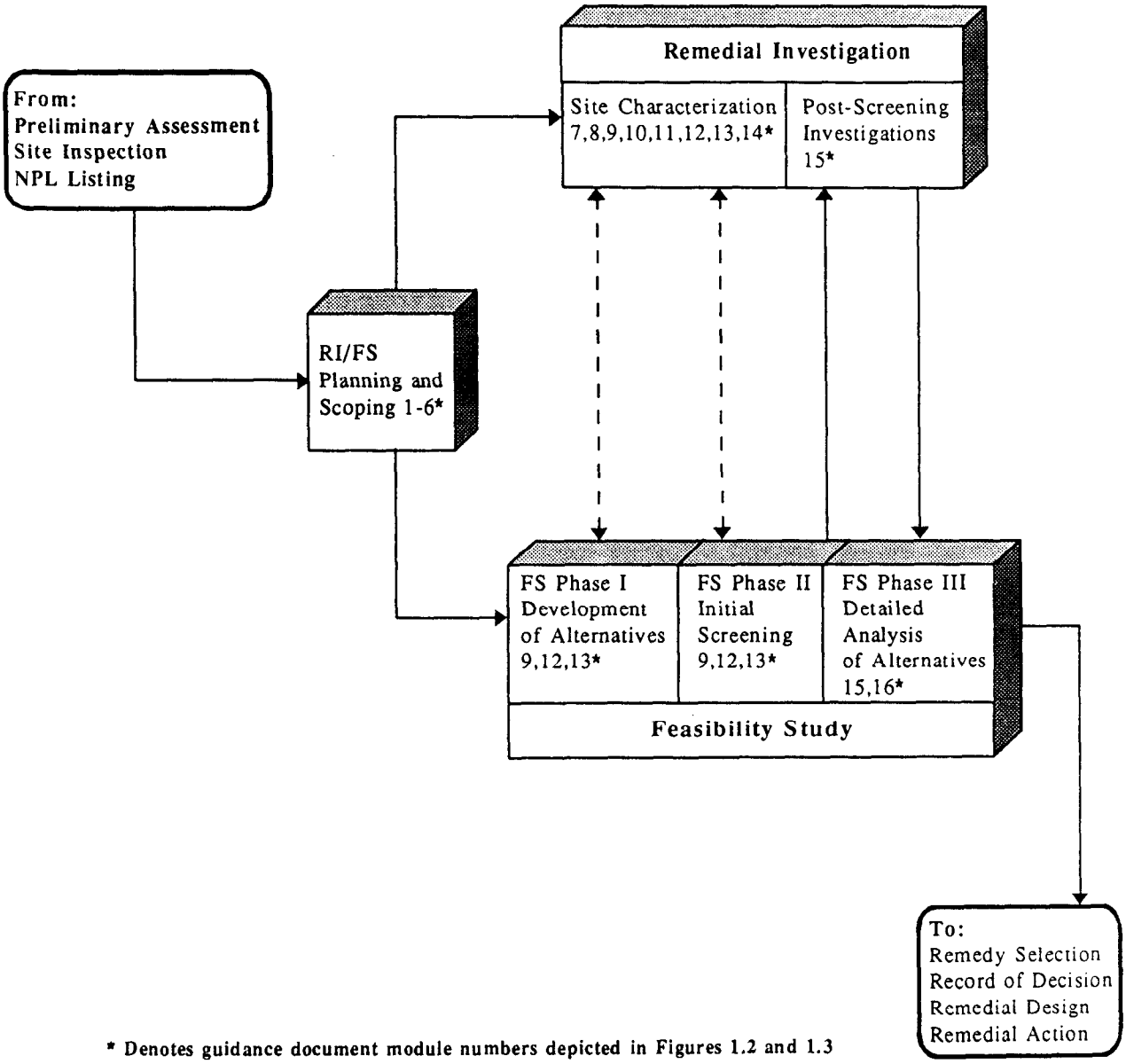
In Part II, each module is presented in "open book" format, with graphical information appearing on the left-hand page and relevant narrative discussion beginning on the right-hand page and continuing on successive pages if needed.

The narrative is used to elaborate details and includes information pertinent to statutory or regulatory citations, milestones, appropriate technical references, and other sources of information.

A master list of references cited in Parts I and II of this document is provided at the end of Part II (Chapter 7). In addition, the specific references cited in each subsection in Parts I and II are listed at the end of that subsection. The complete citations in these subsections are given as they appear in the master list in Chapter 7.

Appendix A of this document provides an example of a generic ecological work plan. Appendices B and C are annotated outlines for an ecological field sampling plan and quality assurance project plan, respectively. Appendix D provides an EPA table of the sensitive environments rating values; while Appendix E is a listing of EPA Regional Biological Technical Assistance Group (BTAG) coordinators and contacts.

The example generic work plan in Appendix A provides guidance on using a phased approach for the review of existing contaminant information, baseline ecological conditions, ecological sampling, and toxicity testing. Stage 1 refers to activities necessary to characterize the baseline (i.e., current) conditions at the site and is covered in Parts I and II of the main text. Stage 3 of the generic work plan includes activities described in Part II of the main text and would be necessary only if baseline ecological conditions were different than conditions at the reference area or if ecological applicable or relevant and appropriate requirements (ARARs) at the CERCLA site were being exceeded.



* Denotes guidance document module numbers depicted in Figures 1.2 and 1.3

FIGURE 1.1 Overview of the RI/FS Process (modified from EPA 1988a)

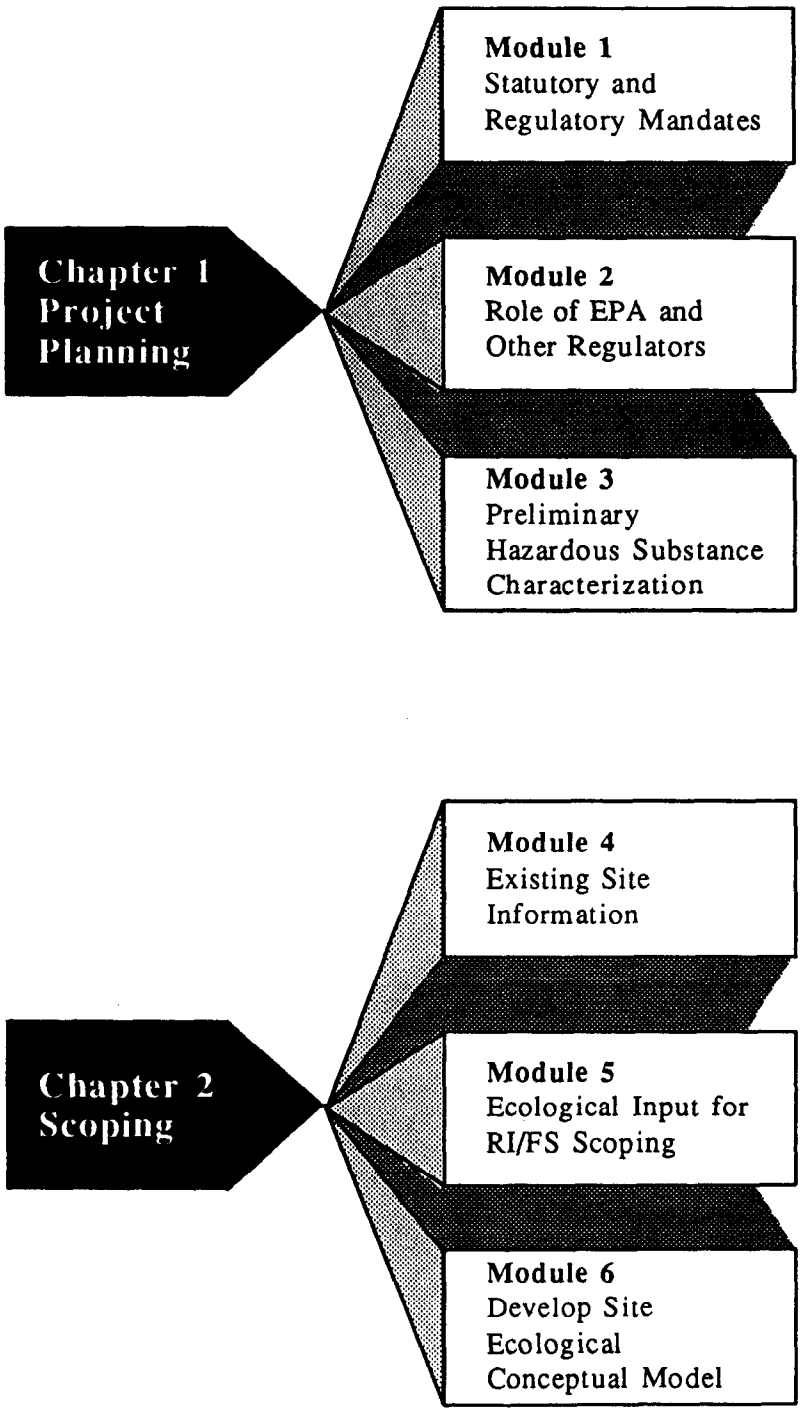


FIGURE 1.2 Planning and Scoping Stages in RI/FS Planning

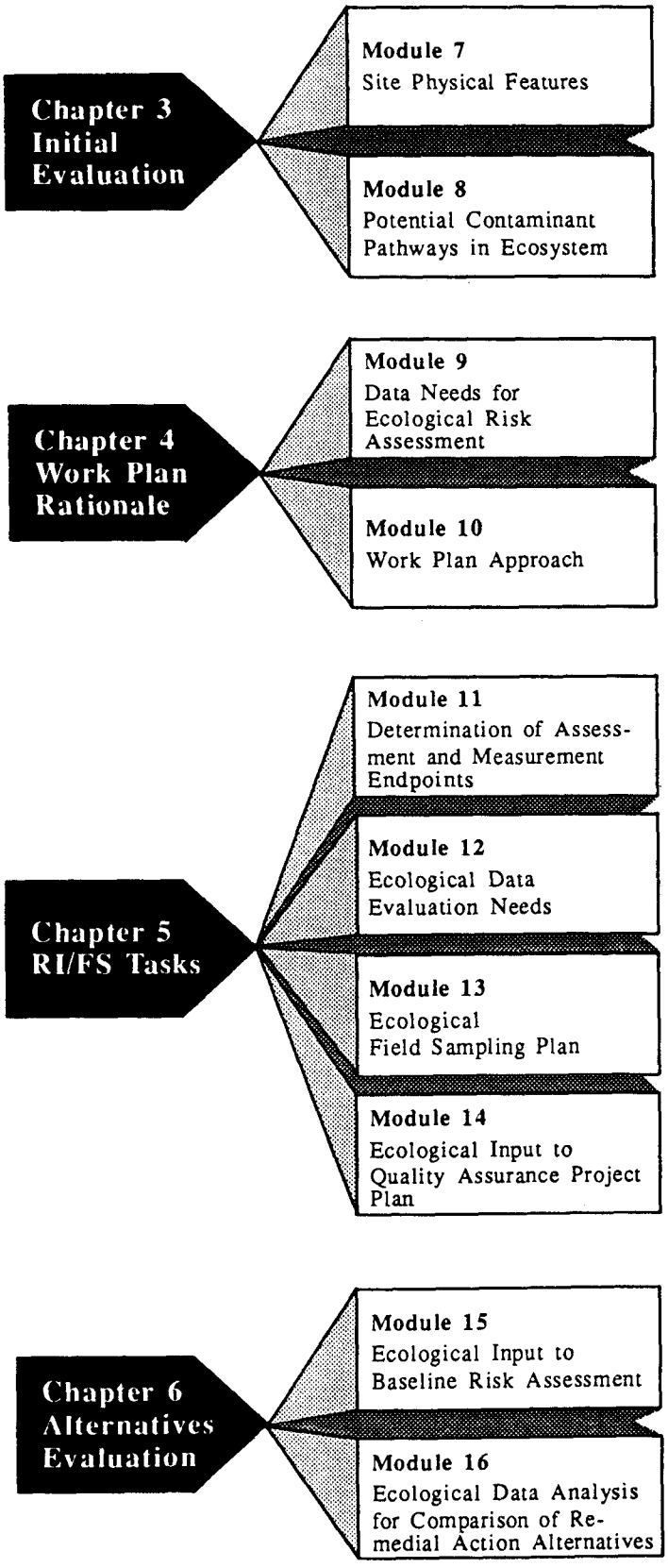


FIGURE 1.3 Work Plan Development and Implementation Stages in RI/FS Planning

KEY TO THE GRAPHIC APPROACH

Purpose: Graphic (i.e., flowchart) guidance provides thorough and accurate information in a logical step-wise format. This guidance document uses diagrams, flowcharts, and supplemental text.

Structure: This guidance document subdivides CERCLA activities pertaining to ecological risk into modules. Each module consists of the following elements:

- Flowcharts presenting a decision process for applying regulations,
- Diagrams showing elements of plans or processes, and
- Text of supplemental explanatory information on the pages opposite the flowcharts.

Headings: Headings label sections of the flowchart and associated supplemental text.

Flowchart symbols: The symbols used in the flowcharts in this document are explained in Figure 1.4.

References

EPA, 1988a. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final*, report EPA/540/G-89/004, OSWER Directive 9335.3-01, U.S. Environmental Protection Agency, Washington, D.C.

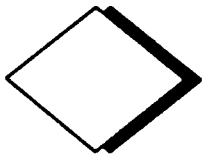
EPA, 1989a. *Ecological Risk Assessment Methods: A Review and Evaluation of Past Practices in the Superfund and RCRA Programs*, report EPA/230/03-89/044, U.S. Environmental Protection Agency, Washington, D.C.

EPA 1992a. *Framework for Ecological Risk Assessment*, report EPA/630/R-92/001, U.S. Environmental Protection Agency, Washington, D.C.

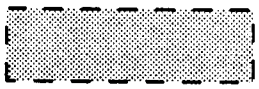
- **Ovals** represent the beginning of a new flowchart;

- **Solid-Line Rectangles** indicate actions that should be completed;

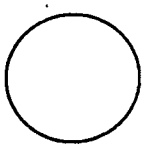
- **Diamonds** represent decision points. (Evaluate the question contained in the diamond and follow the appropriate path: Yes or No);



- **Shaded, Dashed-Line Rectangles** contain notes or "continued on," "continued from," or "proceed to" instructions that direct the reader to different parts of the flowchart or the guidance; and



- **Circles** indicate that the flowchart continues on the next page or continues from the previous page of the flowchart.



- **Books** signal reference callouts.

FIGURE 1.4 Explanation of Flowchart Symbols